

REMARKS/ARGUMENTS

The office action dated February 24, 2003 has been carefully reviewed and these remarks are responsive thereto. Reconsideration and allowance of the instant application are respectfully requested.

The specification has been amended to correct typographical errors in accordance with the Examiner's request and to conform the specification with claim 3 as originally filed to clarify the types of gases that may be used in the processes of the invention. Claims 1-18 remain pending in this application. Claims 1-3 and 6 have been amended. New claims 7-18 have been added. Support for these amendments can be found in the claims as originally filed and throughout the specification. No new matter has been added.

Abstract

The Abstract is objected to as not being directed to the claimed invention and not reciting the steps of the process. The Abstract has been amended. Withdrawal of this objection is respectfully requested.

Claim Rejections Under 35 U.S.C. § 112

Claims 1-6 are rejected under 35 U.S.C. § 112, first paragraph, because the specification does not provide enablement for the process as generically claimed. The Office Action states that the specification is enabling for the production of multiple phase composite materials. Thus, this rejection is understood to mean that the specification is not enabling for processes of pressureless sintering to consolidate and densify fibrous monolith materials. The rejection is respectfully traversed.

The specification discloses that “[o]perating parameters of pressureless sintering are adjusted according to the material characteristics of the particular FM composite being sintered. These parameters are dictated in large part by the melting points of the constituents....” (Page, 10, lines 3-5). One of ordinary skill in the art would be able to practice the claimed invention without undue experimentation knowing that the sintering conditions are dependent on the melting points of the particular ceramic powders used in the two or more compositions of the fibrous monolith. One of ordinary skill in the art also would know to refer to any standard handbook or reference text that lists melting points of chemical compounds to identify a desired

upper limit for the sintering temperature based on the properties of the two or more compositions of the fibrous monolith. One of skill would be able to select a sintering temperature to avoid heating beyond the melting points of all of the compositions of the fibrous monolith. Furthermore, the specification provides several working examples, including material compositions and sintering temperatures, that would also help guide one of skill in the art in practicing the invention. The Office Action later notes at page 5, “[i]t is well known in the art to sinter at atmospheric pressure.” Applicants submit that a person of ordinary skill in the art would be able to practice the invention based on knowledge in the art, as well as guidance provided in the specification at least at page 10 and in the examples. Reconsideration and withdrawal of this rejection is respectfully requested.

Claims 1 and 2 stand rejected under 35 U.S.C. § 112, first paragraph, because the specification does not disclose the “thermoplastic plasticizer” component recited in claim 1. Claim 1 has been amended to remove this limitation. New claim 8 recites a “plasticizer.” Support for this claim can be found at least at Example 3 at page 14, line 5, and footnotes 5 and 8 of Tables 4 and 5, respectively. Reconsideration and withdrawal of the rejection is respectfully requested.

Claim Rejections Under 35 U.S.C. § 102(b)

Claim 3 stands rejected under 35 U.S.C. § 102(b) as being anticipated by Nakano et al. Nakano et al. do not disclose the invention as presently claimed. Reconsideration is requested for the reason that Nakano et al. discloses fiber-reinforced mullite composite materials that has fiber reinforcement and particle-dispersion reinforcement. Amended claim 3 is directed to a process for consolidating and densifying a fibrous monolith composite by sintering in an inert gas atmosphere at a pressure of no more than about 30 psi. As defined in the specification, “fibrous monolith composite” is intended to mean “a ceramic composite material that includes a plurality of monolithic fibers, or filaments, each having at least a cell phase surrounded by a boundary phase but may include more than one core and/or shell phase.” (Page 5, line 20 – page 6, line 1). Claim 3 has been amended to clarify that it is directed to sintering of a fibrous monolith composite consistent with the description in the specification.

Nakano et al. is directed to a composite that include only one ceramic material composition. According to Nakano et al., an impregnating solution, or mullite matrix slurry, is used to coat and impregnate a preformed reinforcing fiber. Alternatively, Nakano et al. disclose that preformed short fibers can be dispersed within the mullite matrix slurry. Thus, Nakano et al. do not teach processing of a fibrous monolith component formed of one or more filaments including a first uniformly suspended mixture generally surrounded by a second uniformly suspended mixture as presently disclosed and claimed.

Nakano et al. further teach that “a formed body is sintered in an inert (e.g., argon) gas and/or nitrogen gas in a pressurized (for example, not more than about 9 kgf/cm² G) or nonpressurized gas flow.” (Col. 7, lines 8-11). Nakano et al. do not provide any additional disclosure regarding pressureless sintering, including any operating conditions for pressureless sintering. All of the examples of Nakano et al. are directed to sintering in a pressurized gas.

Thus, Nakano et al. fail to teach every element of the claimed invention as required under 35 U.S.C. § 102(b).

Claim Rejections Under 35 U.S.C. § 103(a)

Claims 1 and 2 stand rejected under 35 U.S.C. § 103 as being unpatentable over Lachman in view of deAngelis. Claims 3 and 4 stand rejected under 35 U.S.C. § 103 as being unpatentable over Hseih in view of Sterzel. Claim 6 stands rejected under 35 U.S.C. § 103 as being unpatentable over Fujimoto et al. in view of Yano et al. Reconsideration and withdrawal of these rejections is respectfully requested.

Briefly, the present invention as claimed in claims 1-18 is directed to processes for preparing fibrous monolith composite objects, where the processes include sintering the composite objects in an inert gas or nitrogen gas at atmospheric pressures or at pressures of no more than about 30 psi to provide a consolidated and densified fibrous monolith composite. As defined in the specification, “fibrous monolith composite” is intended to mean “a ceramic composite material that includes a plurality of monolithic fibers, or filaments, each having at least a cell phase surrounded by a boundary phase but may include more than one core and/or shell phase.” (Page 5, line 20 – page 6, line 1). The claims have been amended to clarify that

they are directed to sintering of a fibrous monolith composite consistent with the description in the specification.

Claims 1 and 2 stand rejected under 35 U.S.C. § 103 as being unpatentable over Lachman in view of deAngelis. This rejection is respectfully traversed. The cited documents, either alone or in combination, do not disclose, teach or suggest the invention claimed in claims 1 and 2 or any of new claims 7-18. Amended Claim 1 is directed to a process for producing fibrous monolith components that includes forming two uniformly suspended mixtures into a feed rod, extruding the feed rod to form a fibrous monolith preform, heating the preform to remove binder, and heating again to sinter the preform at a pressure of no more than about 30 psi to provide a sintered fibrous monolith component. Claim 2 depends from Claim 1 and specifies that at least one of the mixtures includes a sintering aid. Neither Lachman nor deAngelis alone or in combination disclose, teach or suggest pressureless sintering of a fibrous monolith component.

Lachman teaches forming extruded articles from at least two sinterable materials that are substantially uniformly distributed throughout the article. Significantly, the two or more phases of the article of Lachman are arranged so that both phases are substantially discontinuous. Lachman does not teach or suggest forming a fibrous monolith component from a composite feed rod that includes a central first material generally surrounded by an outer, second material.

Lachman also does not teach the use of sintering aids. The Office Action states that “the materials disclosed by Lachman (col. 3, lines 45-60) include known sintering aids such as titania and alumina.” Lachman, however, simply discloses that “the extruded laminated articles of this invention are made [sic] may be any of the wellknown sinterable inorganic materials capable of providing mechanical strength and good thermal properties.” (Col. 3, line 35-39). Lachman then lists “[e]xamples of suitable materials” for forming the articles of the invention at the cited lines of the specification but does not disclose, teach or suggest that the example materials may be used as sintering aids or have any use other than as the primary materials for forming the articles. (See col. 3, line 35-col. 4, line 41). Moreover, Lachman does not teach or suggest pressureless sintering of the extruded article. The limited disclosure relating to sintering of the extruded article of Lachman does not teach or suggest conditions for pressureless sintering. Accordingly, the present claims are not obvious in view of Lachman.

deAngelis does not provide any teachings to cure the deficiencies of Lachman. deAngelis teaches a method of rapid prototyping through controlled layerwise deposition and extraction of materials. The method includes a sequence of operations wherein part material and complementary support material are deposited separately and removed layer-by-layer to build a part surrounded by the complementary materials. deAngelis does not disclose, teach or suggest pressureless sintering of the formed parts. Accordingly, the present claims are not obvious in view of deAngelis.

Claims 3 and 4 stand rejected under 35 U.S.C. § 103 as being unpatentable over Hseih in view of Sterzel. This rejection is respectfully traversed. The cited documents, either alone or in combination, do not disclose, teach or suggest the invention claimed in claims 3 and 4 or any of new claims 7-18. Amended Claim 3 is directed to a process for consolidations and densification of fibrous monolith components that includes placing a preformed fibrous monolith composite formed of one or more filaments having a central portion of a first uniformly suspended mixture and an outer portion of a second uniformly suspended mixture essentially surrounding the central portion in a sintering furnace containing an inert gas or nitrogen gas and heating the fibrous monolith composite at a pressure of no more than about 30 psi to provide a sintered fibrous monolith composite. Claim 4 depends from Claim 3 and specifies that the fibrous monolith composite includes Si_3N_4 , BN and a sintering aid. Neither Hseih nor Sterzel alone or in combination disclose, teach or suggest pressureless sintering of a fibrous monolith component as disclosed and claimed.

Hseih teaches pressureless sintering of a single phase composition that includes a mixture of silicon nitride and boron nitride. Hseih does not disclose sintering of a composite that includes two separate uniformly suspended mixtures where the sintering densifies both uniformly suspended mixtures. Sterzel does not provide any teachings to cure the deficiencies of Hseih as Sterzel is directed to stabilization of foamed starting slip materials and processes for producing sintered inorganic foamed parts. Sterzel does not disclose, teach or suggest processes for consolidating and densifying fibrous monolith composites to provide sintered fibrous monolith composites. Accordingly, the present claims are not obvious in view of Hseih or Sterzel.

Claim 6 stands rejected under 35 U.S.C. § 103 as being unpatentable over Fujimoto et al. in view of Yano et al. This rejection is respectfully traversed. The cited documents, either alone or in combination, do not disclose, teach or suggest the invention claimed in claim 6 or any of new claims 7-18. Amended Claim 6 is directed to a method for manufacturing a fibrous monolith article that includes forming a fibrous monolithic material in the form of a filament and including a first material composition generally surrounded by a second material composition, processing the filament to provide a preform of the article and sintering the preform generally at atmospheric pressure to provide a dense, sintered article.

Fujimoto et al. disclose a porous ceramic substrate, or sheet, for use as wiring substrates of boards used in electronic parts. The sheets are formed from one material composition that is extruded into a 6 mm rod and rolled down into a sheet. Fujimoto et al. do not teach or disclose formation of a fibrous monolithic filament and subsequent processing of the filament to shape and finish the filament to provide a sintered fibrous monolith article. The Office Action acknowledges that although Fujimoto et al. teach that the sheet is sintered, Fujimoto et al. do not teach the conditions of sintering.

Yano et al. do not provide any teachings to cure the deficiencies of Fujimoto et al. Yano et al. disclose a semiconductor package and semiconductor device that can cope with high heat generation. The package substrate is a single layer substrate that is formed by compressing a ceramic powder into a green sheet, which is then sintered and densified in an inert gas atmosphere. Although Yano et al. also disclose that either a single-layer or multi-layer substrate can be formed, Yano et al. do not disclose formation and processing, including pressureless sintering, of a fibrous monolith article formed of a filament including a first material composition generally surrounded by a second material composition. Accordingly, the claimed invention is not obvious in view of either Fujimoto et al. or Yano et al.

In view of the above, reconsideration and allowance of the pending claims are respectfully requested.

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Amendment dated May 27, 2003
Reply to Office Action of February 24, 2003

CONCLUSION

It is believed that no fee is required for this submission. If any fees are required or if an overpayment is made, the Commissioner is authorized to debit or credit our Deposit Account No. 19-0733, accordingly.

All rejections having been addressed, applicant respectfully submits that the instant application is in condition for allowance, and respectfully solicits prompt notification of the same.

Respectfully submitted,

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